Thought question

Suppose that you believe that ADHD is a "filtering problem". That is, you think that individuals with ADHD have the same attentional capacity as individuals without this problem, but that they don't select the "right" information to filter out. To test your hypothesis, you show children with and without ADHD some pictures of familiar objects to remember for later. You then test their memory for the pictures. How do you expect the performance of the two groups to differ? Now, suppose you test the same two groups of children on their memory for the posters that were hanging on the wall in the testing room. What do you expect to find and why?

Two types of attention

- Focused attention
  - Select to attend to some, ignore others
  - Present with multiple stimuli and ask to respond to only one
- **Divided attention**
  - **Try to do multiple tasks at same time**
  - **Present with multiple stimuli and ask to respond to more than one**

Divided Attention

- Try to do multiple tasks at same time
- Present multiple stimuli and ask for response to more than one

Research Questions

- How much capacity do we have?
- Is there one set of resources shared by all kinds of processes or are there multiple “pools” of resources?
- Are there any processes that don’t require attentional resources?

Divided Attention

- **Capacity of Attention**
    - **dual-task method**
- General or Specific?
    - similarity of concurrent tasks
- Attention-free processes?
    - feature search vs. conjunction search

Divided attention

- **Sometimes there are two information sources that need to be responded to at the same time.**
- **Everyday experience tells us that this can be difficult. But why?**
    - **interference?**
    - **limits in capacity?**
    - **both?**

Testing divided attention

- Have people do two things at once
  ⇨ DUAL TASK PARADIGM
- Subjects have to pay attention -- and respond -- to two different things.
  - compare dual task performance with performance on one task alone
  - compare dual task performance for different pairings of tasks

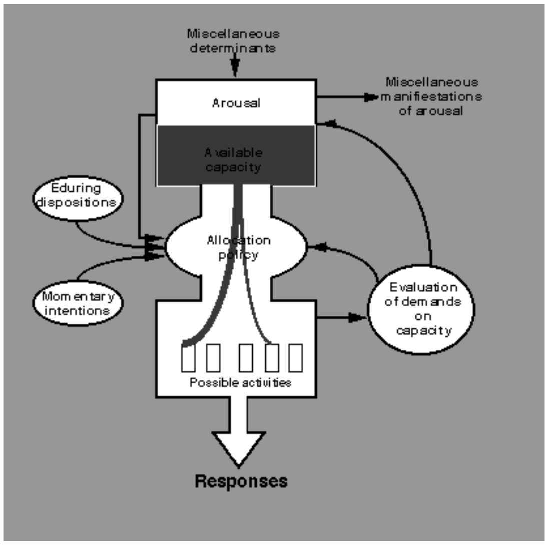
Dual task cost

- Measure reaction time to each task when performed alone.

- Measure RT to Tasks 1 and 2 performed together.

- If RT is longer for doing two things, this is the “cost” of divided attention.

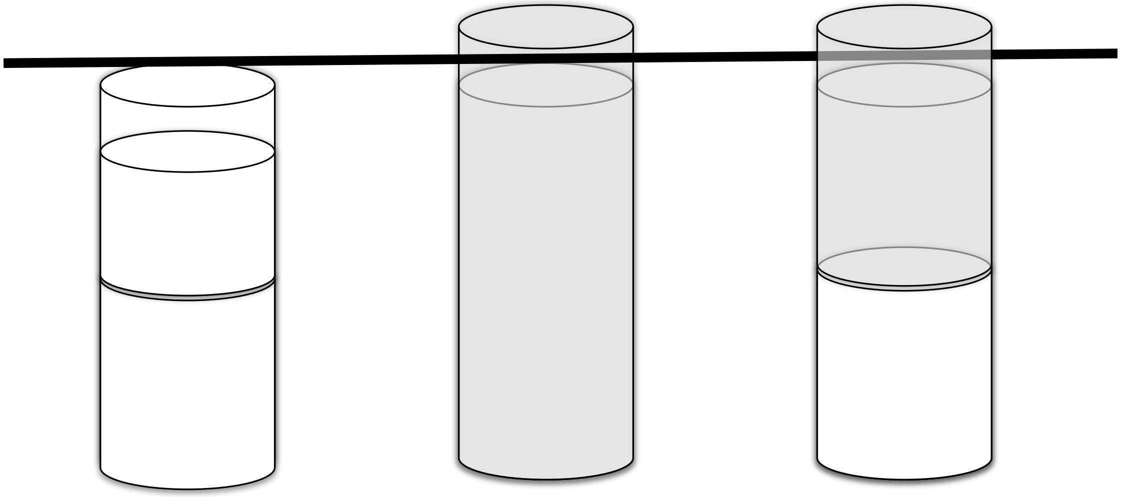
Central capacity model



- **Limited resources.**
- **Some tasks need more attention than others.**
- **We can do two things in parallel (no cost) if capacity is not exceeded.**
- **Will see dual task cost if demands of tasks exceed capacity.**

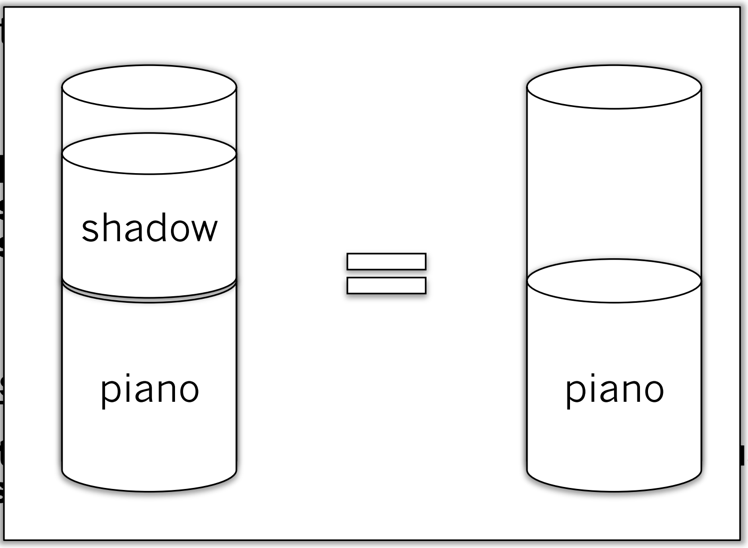
Capacity model

- Processing cost only when you go over capacity...



Combining tasks with no cost?

Allpor



- **asl**
  1. s
  2. s

- **Re**

  Wit ual
  tas

Interpretation

- **No cost if task demands do not exceed total resources available.**
- **BUT . . .**
  - **maybe could switch between tasks**
  - **maybe one task doesn't require attentional resources**

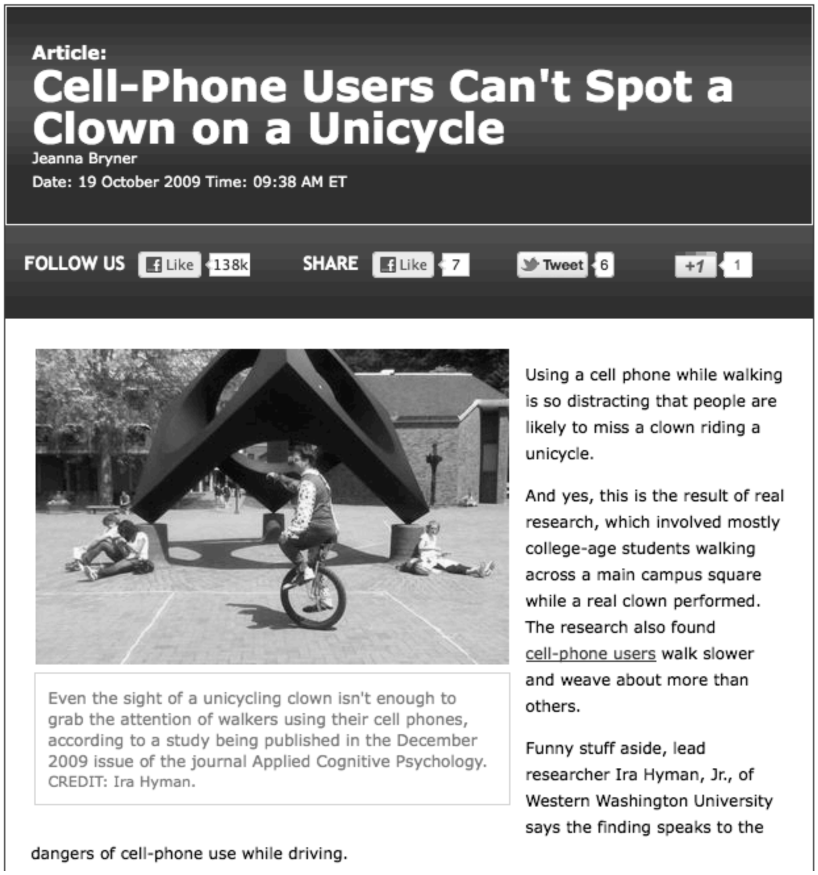
Effects of task difficulty

Sullivan (1976)

- **Subjects did a dichotic listening task: shadow message in one ear while listening for and responding to tones on the other.**
  - **Shadowing “simple” message**
  - **Shadowing “complex” message**
- **Result:**
  - **Tone detection worse when shadowed message *complex***

Dual-task Costs

- Lots of new findings that every-day dual tasks cause processing difficulty
  - Use of a cell phone while driving increases risk of an accident by 4 times (Redelmeier & Tibshirani, 1997)
    - attributed to attention rather than motor problem
- Can we test this theory experimentally?
  - Cell phone studies
    - cell phones and walking
    - cell phones and driving



Article:

Cell-Phone Users Can't Spot a Clown on a Unicycle

Jeanna Bryner

Date: 19 October 2009 Time: 09:38 AM ET

Even the sight of a unicycling clown isn't enough to grab the attention of walkers using their cell phones, according to a study being published in the December 2009 issue of the journal Applied Cognitive Psychology. CREDIT: Ira Hyman.

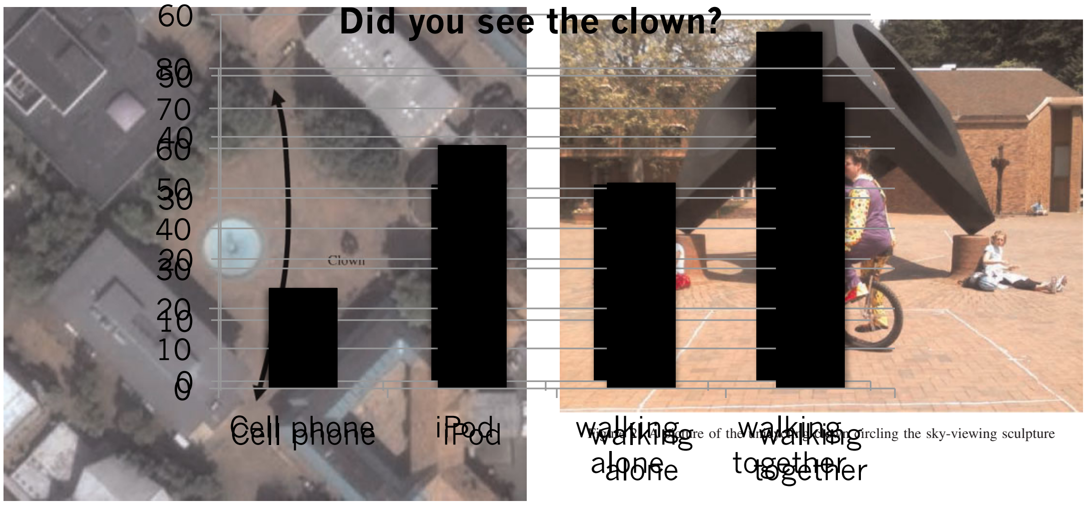
Using a cell phone while walking is so distracting that people are likely to miss a clown riding a unicycle.

And yes, this is the result of real research, which involved mostly college-age students walking across a main campus square while a real clown performed. The research also found cell-phone users walk slower and weave about more than others.

Funny stuff aside, lead researcher Ira Hyman, Jr., of Western Washington University says the finding speaks to the dangers of cell-phone use while driving.

Clown Study (Hyman, et al. 2010)

Did you notice anything?



Did you see the clown?

Figure 1. Overhead picture of WWU's Red Square with the common diagonal path marked (used in Studies 1 and 2) and location of the unicycling clown (Study 2)

Figure 2. A picture of the unicycling clown circling the sky-viewing sculpture

Driving Studies

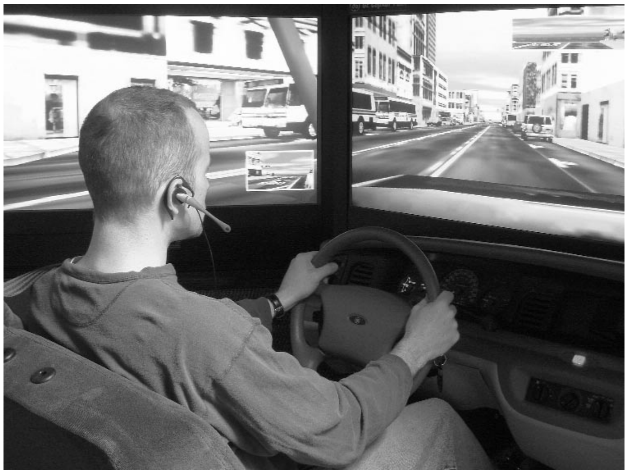
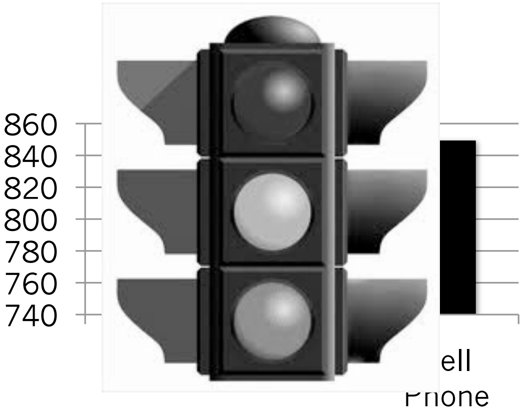


Figure 1. A participant talking on a cell phone while driving in the GE-ISIM driving simulator.

Driving Studies



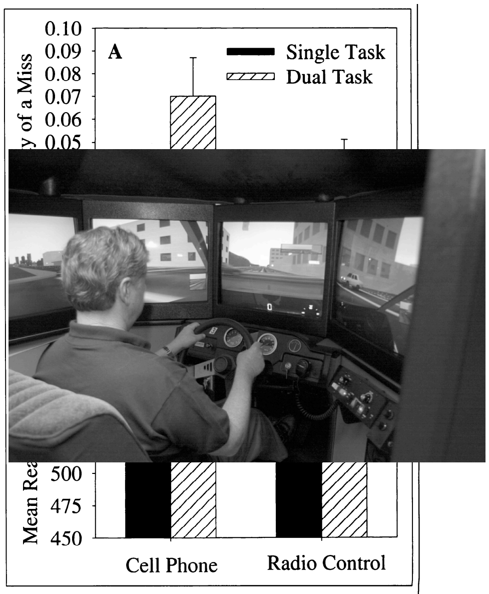


Fig. 1. Probability of missing the simulated traffic signals (a) and mean reaction time to the simulated traffic signals (b) in single- and dual-task conditions in Experiment 1.

Dual-task Costs: Summary

- Lots of new findings that every-day dual tasks cause processing difficulty
- Cell phones impair walking
- Cell phones impair driving
  - like being drunk
  - hands-free doesn't help

TSA

Summary

- **Support for central capacity models:**
  - **sometimes two tasks do not interfere**
  - **other times, tasks *do* interfere and this inference is greater when tasks are harder**

Divided Attention

- Capacity of Attention
  - dual-task method
- General or Specific?
  - similarity of concurrent tasks
- Attention-free processes?
  - feature search vs. conjunction search

Question

Are resources . . .

GENERAL?

or

SPECIFIC?

General resources

If resources are *general*:

- **tasks will compete for same general resource pool**
- **costs will occur if the combined demand from the tasks is greater than the resources available**
- ***nature* of the task doesn't matter**

Specific resources

If resources are *specific*:

- **different resources are available (e.g., auditory and visual)**
- **tasks require specific kinds of resources**
- **costs will only occur if tasks use the same resource pool, and exceed that pool's capacity**
- **nature of the task is critical**

Testing for specific resources

Allport et al (1972)

Two tasks:

(1) shadow a set of (auditory) words

(2) remember a second set of items to be recalled later.

Critical manipulation

- **Second set of items presented three ways, which *vary in their similarity to the shadowing task.***
  - **words presented in other ear (very similar)**
  - **words presented visually (moderately similar)**
  - **pictures (dissimilar)**

Results

- Memory for:
  - auditory words: terrible
  - visual words: okay
  - pictures: excellent
- Supports notion of specific resources
  - visual vs. auditory
  - verbal vs. spatial

Specific vs. general, continued

- But sometimes seem to get interference from dual tasks even when very dissimilar.
- Example: driving and talking
  - Very dissimilar on stimulus side
  - Very dissimilar on output side
  - Probably not competing for specific resources
  - But do interfere

- Both tasks must draw on a *general* resource pool which is limited.

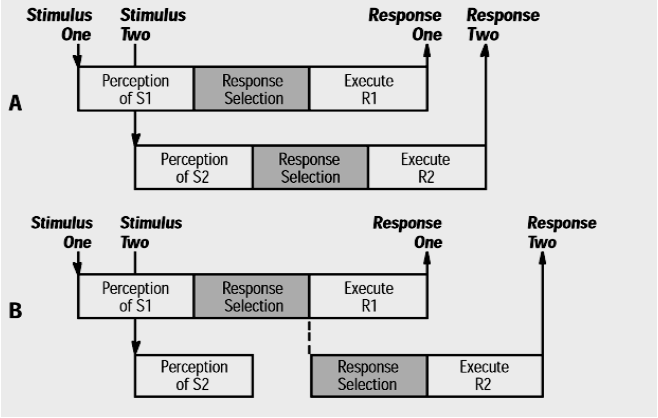
Specific vs. general, continued

- **Possible that there are different kinds of attentional resources.**
  - **Some specific, required by only some kinds of tasks**
  - **Some general, required by ALL tasks.**

What are general resources?

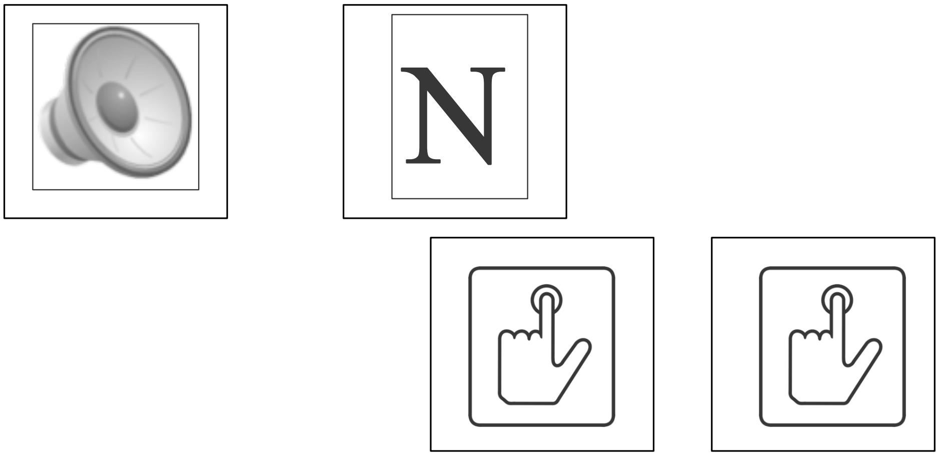
- **Some processes might be necessary for all tasks.**
  - **E.g.: setting goals, *selecting responses***
- **Response selection:**
  - **mechanism for selecting next response to be executed**
  - **can initiate only one response at a time**
  - **if two tasks require response selection, one must wait.**

Response selection

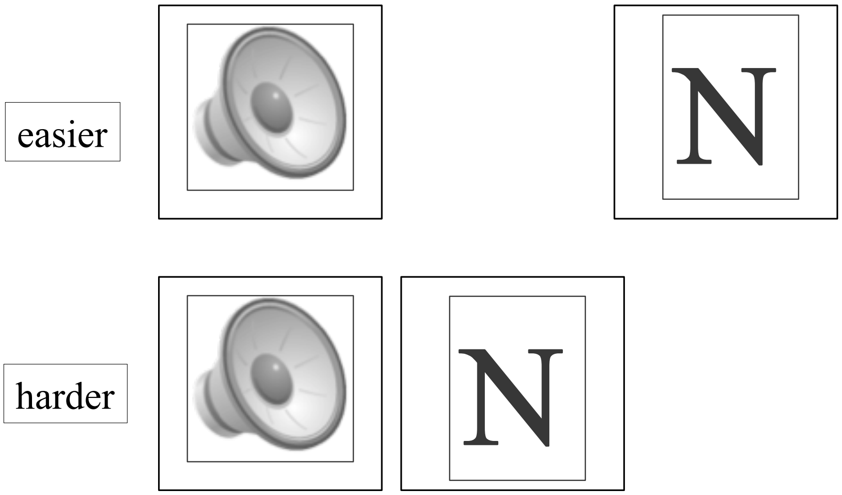


Might see interference between two tasks because of limited general resources.

“Psychological refractory period”



“Psychological refractory period”



easier

harder

“Psychological refractory period”

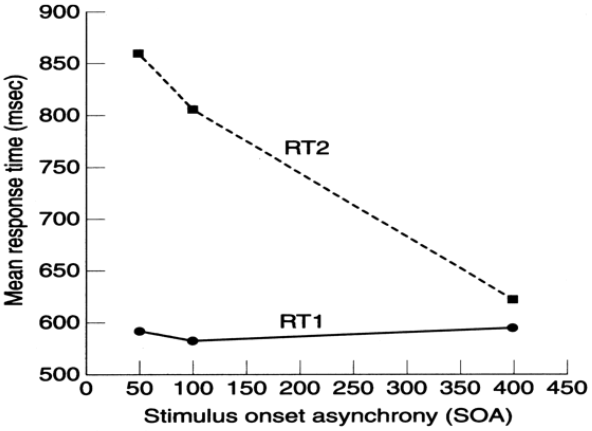


FIG. 4.1. RT for Task 1 and Task 2 in a dual-task experiment requiring separate responses to a tone (first stimulus) and a letter (second stimulus). Stimulus onset asynchrony refers to the time between onset of tone and letter. RT1 is time for response to tone; RT2 is time for response to letter. (Data from Experiment 1, Pashler & Johnston, 1989.) The slowing of RT2 at shorter SOAs is referred to as the psychological refractory period (PRP) effect.

Summary

- **There is evidence for both task specific and task general resources and their limited supply.**
- **Successful dual task performance is possible only if *both* resources can be managed efficiently.**
- **There are different “kinds” of attention -- different sources for limitations on behavior.**

Divided Attention

- Capacity of Attention
  - dual-task method
- General or Specific?
  - similarity of concurrent tasks
- Attention-free processes?
  - feature search vs. conjunction search

Question

Can some things be done without attention?

Visual Search

- Method:
  - Give item (target) to search for
  - Show display
  - Measure reaction time (RT) to respond
- Terminology
  - Target: item you are searching for
  - Distractors: other items in display
  - Display size: total number of items in search set

Find the purple “T”

raise hand when you do

		T	X		X	X
X			T	T		
T		T	X		T	
	X					

X T T X T

T X X T T X

T X X X

X T X X T T

T T X T

X T T T X

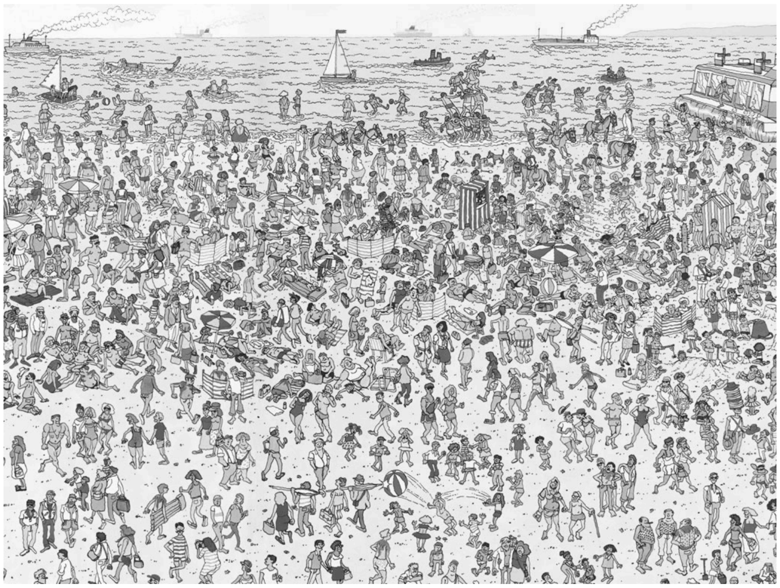
T X T X

Find the blue “T”

```
X        T  X     T
 T X  X
      T        X  X
X  T  X     X     T
      T  X     T
   X        T     T     X
T              T
```

```
XXT   X     T     T     XTT   X     T
  T   X     X     TXT  TX           T     X
      T     XT    X     T X   XX
X     T     X           XT          TT    T
T X    X T  X           T     XX
      X X   TX    XT          TT          X
T                 X T  T        TX        X
  X         X           TTX   T     X           T
TT XT       XTX   T     TT    XT    XX
```

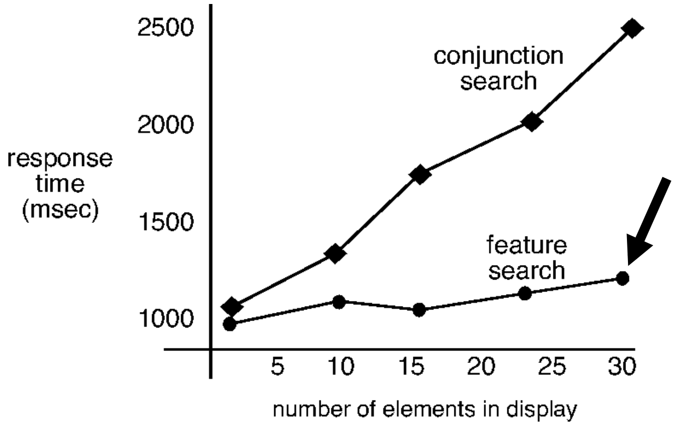
Find Waldo …



Results

When target differs from distractors by only one feature (**single feature search**), response time does not vary with display size.

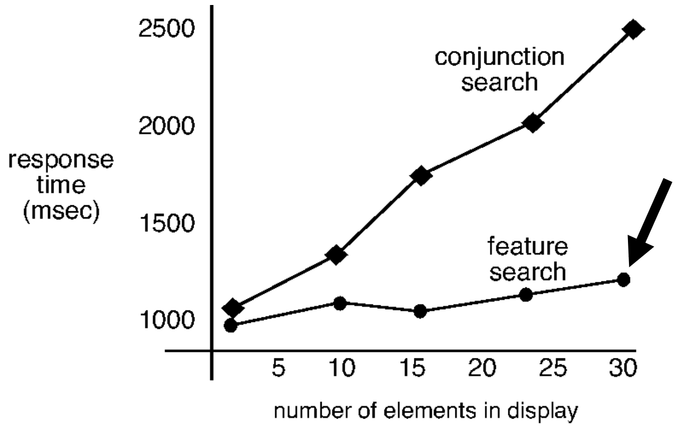
“Pop-out”effect.



Results

Suggests that individual features (like color) can be processed all over the display at the same time.

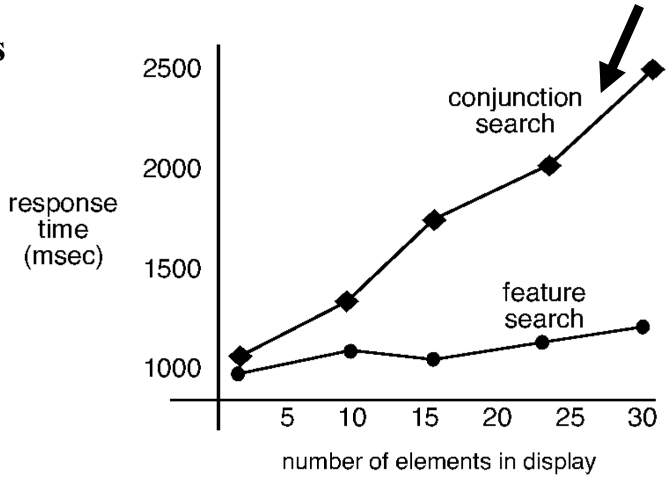
So getting information about individual features does NOT seem to require attention.



Results

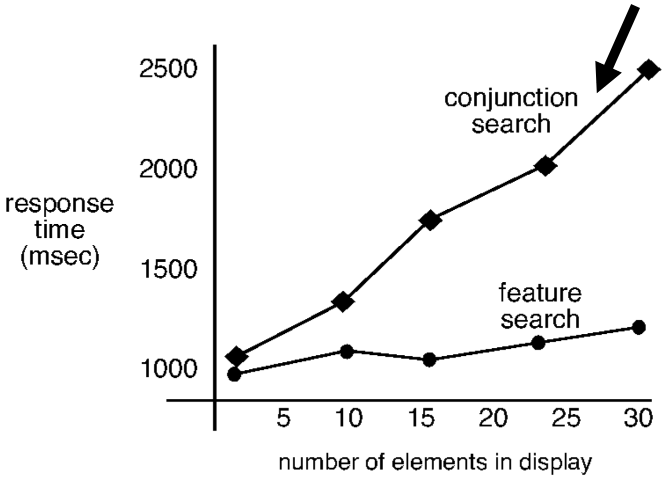
Searching for **conjunctions** of features takes more time when there are more items in the display.

Suggests need to attend to parts of the display successively in order to process conjunctions.



Results

So conjunction search REQUIRES attention.

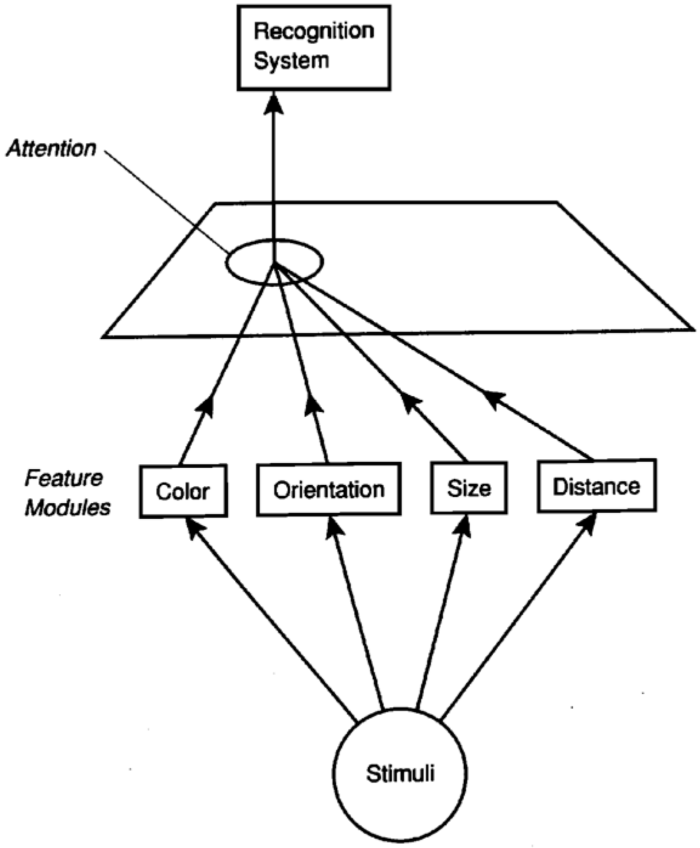


When is attention needed?

Treisman and Gelade (1980)

- **“Feature integration theory”**
- **Role of attention is to combine features into objects**
- **Have two processes:**
  - **Rapid, automatic, parallel processing of individual features**
  - **Slower, effortful, limited (serial) process that combines features**

Treisman's Feature-Integration Theory



Visual search reveals that ...

- Some information can be processed with little attention.
    - For this kind of information, display size does not matter.
- One role of attention is to "glue together" information that comes from the same spatial location.
    - For this process, RTs increase with the number of items on the display.

Conclusions

- **Attention is not a single skill or a unitary faculty of the mind.**
- **Attention is a *family of processes* which**
  - **ensure effective processing by facilitating some inputs and suppressing others**
  - **involve the allocation of limited resources, both task specific and task general**

Thought question

Feature integration theory says that spatially directed attention is required to correctly “bind” feature information. Suppose that we run the following experiment. Participants are asked to fixate at the center of a screen, where a number will be presented that they have to report. At the same time, in the visual periphery we rapidly present pairs of colored letters (T L). After participants have correctly reported the central number, we ask them to also describe what they have seen in the periphery. If Feature Integration Theory is right, what should we expect to observe?